

2001 Lake St. Clair Assessment

EXECUTIVE SUMMARY

Background

The Clinton River Watershed encompasses most of Macomb and Oakland Counties, with small portions extending into Lapeer and St. Clair Counties. It drains approximately 760 square miles, an area which is populated by an estimated 1.5 million persons, before reaching Lake St. Clair. The majority of the land within the watershed is developed for industrial, urban and suburban uses. Although agriculture is still common along the North Branch of the Clinton River, farmland is diminishing rapidly due to urban expansion. Since urban expansion alters natural drainage, an increasing amount of water reaches Lake St. Clair via storm water systems.

The water flowing through Lake St. Clair is a precious natural resource that provides drinking water for millions, numerous recreational opportunities and is essential to the businesses and homeowners adjacent to the shoreline. Notwithstanding the importance of Lake St. Clair, many water quality problems exist. In 1985, the International Joint Commission designated the lower Clinton River basin as an Area of Concern, due to elevated fecal coliform bacteria, total dissolved solids levels, contaminated sediments, and a degraded benthic macroinvertebrate community. Since 1994, the Macomb County Health Department frequently closed beaches on Lake St. Clair due to violations of Total Body Contact Standards for indicator bacteria. Early in 1997, Macomb County established the Blue Ribbon Commission on Lake St. Clair to develop an action plan addressing water quality issues. Monitoring water and sediment quality was the first of four key elements the Commission listed as necessary in solving the problems facing Lake St. Clair. The water quality concerns in Lake St. Clair and the Clinton River Watershed include pathogens, toxic contaminants and eutrophication.

Scope of the Study

The project included five complementary monitoring activities; near shore, off shore, watershed, bathing beach, and wet weather event. The near shore testing was conducted at 23 major outfalls to the lake, including the mouths of the Clinton River and Spillway, urban storm drains, smaller rivers and creeks and retention basin discharge points. Off shore sampling was conducted at 11 sites, approximately one-quarter mile from shore. Seven of the off shore locations correspond to major near shore sample locations, two were adjacent to public beaches and two were municipal drinking water intake sites. Water chemistry and sediment bacteriological samples were collected during the spring, summer and fall seasons at near and off shore sites. Near shore water bacteriological samples and water quality meter readings were collected weekly from late April through September. Off shore water bacteriology sampling and water quality meter readings were collected during the spring, summer, and fall seasons. Sediment chemistry samples were collected at 7 near shore locations. Lake Sediment samples were collected at 20 locations for mercury analysis. Aqueous samples for trace mercury analyses were collected at 10 sites on the lake and 6 sites in the watershed.

Concurrent sediment and water samples were collected at 20 locations in the watershed for bacteriological examination during the spring, summer and fall. Additionally, sediment chemistry samples were collected at 5 locations.

Bathing beach water and sediment sampling was conducted at 15 sites on the public beaches along Lake St. Clair (Blossom Heath, Memorial Park, HCMA Metropark, and New Baltimore). Samples were collected monthly from May through September 2001 and analyzed for aqueous and sediment bacteriology.

Event sampling was conducted in the watershed in response to rain events exceeding one half inch in a 24-hour period. Water samples were collected for bacteriological analysis at 20 strategic locations between April and September. Sample locations were selected based on three criteria: proximity to known sewer overflows, locations of frequently high bacteria counts and at the most downstream sample site of each major sub-watershed drainage area of the Clinton River.

Results and Observations

Water chemistry data (nitrate, TKN, ammonia, ortho-phosphorus, total phosphorus, BOD, TOC, chloride and aluminum) was collected at all near shore and off shore sites during the spring, summer and fall. This data was evaluated for seasonal and spatial variations. Spatial variations between near shore and off shore sites, and between northern and southern near shore sites were evaluated. Southern near shore sites included sites south of the Clinton River Spillway, while northern sites included those from the spillway north. Significant seasonal and spatial variations in the data were observed at both near and off shore sample locations. Near shore sites had significantly higher results than off shore sites for all parameters except nitrate, ammonia and TOC. Northern near shore sites had significantly higher results than southern sites for all parameters except TKN, ortho-phosphorus and aluminum.

The near shore data was also evaluated for differences in sample location. Four categories of sample locations were used including the mouths of the Clinton River and Spillway, retention basin discharge points, urban storm drains, and the mouths of smaller rivers and creeks. The Clinton River and Spillway had significantly higher levels for all water chemistry parameters, with the exceptions of aluminum and ammonia. Urban storm drains had significantly lower levels of nitrate, ammonia, ortho-phosphorus and turbidity than the other types of sample sites.

Sediment samples were collected at seven near shore and five watershed sample sites. The samples were analyzed for Kjeldahl nitrogen, ammonia, total phosphorus, TOC, COD, arsenic, cadmium, chromium, copper, lead, zinc, mercury, nickel, total petroleum hydrocarbon, oil and grease, PCBs, PNAs and pesticides.

Results of metals analysis were compared to Ontario Ministry of Environment and United States Environmental Protection Agency sediment metal pollution classification guidelines. All of the metals exceeded a guideline, at least once, at a near shore or watershed sample location. All seven of the near shore sites sampled exceeded at least four of these guidelines. The Milk River, Clinton River and Irwin Relief Drain exceeded the greatest number of guidelines. Four of the five watershed sites sampled exceeded at least one of these guidelines.

Results of PCB and PNA analysis were also compared to Ontario Ministry of Environment and United States Environmental Protection Agency sediment classification guidelines. PCB's were detected at two of the 12 monitored sites in the lake and watershed. PNAs were detected at seven of the 12 monitored sites in the lake and watershed. All results exceeded

the guidelines.

Pesticides were not detected at any of the 12 sites monitored in the lake and watershed.

Samples were collected for sediment mercury analysis at seven near shore sites, five watershed sites, and at 20 sites in the U.S. portion of Lake St. Clair where mercury was detected in 2000. Mercury was detected at three near shore sites and one watershed site, three of which exceeded the Ontario Ministry of Environment critical value. Mercury was also detected at seven of the 20 sites in the lake. All seven sites were adjacent to the shipping channel. Four results exceeded the critical value. At fourteen sites the concentration was lower than in 2000.

To determine the current input of mercury from the major outfalls to Lake St. Clair, aqueous samples for trace mercury analysis were collected at 16 sites in the lake and watershed. It is notable that the results from aqueous samples collected at the mouths of the North and South Channel were the lowest and only samples that did not exceed the critical value, while in the lake sediments mercury was detected adjacent to the shipping channel and at the mouth of the North Channel. Additionally, the Milk River had the highest aqueous mercury, while the highest sediment mercury in 1998, 1999 and 2001 was also found at the Milk River.

Near shore and off shore sites were ranked by the geometric mean of their E. coli concentrations over the entire sampling season. The highest annual near shore E. coli level was found at the Milk River, 48 E. coli/100 mL. The lowest annual near shore levels were found at the 12 Mile Relief Drain and Lake Blvd. Relief Drain, both 1 E. coli/100 mL. The highest annual off shore E. coli levels were found at Clinton River Spillway, 33 E. coli/100 mL. The lowest annual off shore counts were found at St. Clair Shores Coast Guard Station and Milk River, both 1 E. coli/100 mL.

Average near shore E. coli concentrations for each sampling date and depth of precipitation within 72 hours prior to each sampling date were plotted as a line graph together over time. Correlation analysis of average near shore E. coli levels for each sampling date and total rainfall 72 hours prior to sampling revealed a strong correlation ($r = 0.82$). A simple linear regression model predicting average near shore E. coli in terms of the depth of precipitation within 72 hours prior to sampling was performed. The predictor variable explains 67% of the variation in the response, with a 95% confidence interval of ± 306 cfu/100ml.

Correlation analysis of sewer overflows and E. coli levels were not possible because only one sewer overflow occurred within 72 hours of a sampling event.

The Clinton River Watershed was sampled during periods of rain at 20 strategic locations. The results were assessed in terms of their correlation to the sum of the rainfall in the 72 hours prior to sampling. No statistically significant correlation was found between rainfall and bacterial event samples.

Sediment and aqueous E. coli samples were collected concurrently at beach, near shore, off shore and watershed sample sites. No statistically significant correlation could be established between aqueous and sediment E. coli levels.

The average dissolved oxygen (DO) concentrations at the near shore sites was found to be significantly higher than the off shore sites. None of the sites had an average DO below the desired value of 7 mg/L.

The average turbidity exceeded the critical value of 25 NTU at 11 near shore sites and 4 off shore sites. The average turbidity at the northern sample sites exceeded the critical value, and was found to be significantly higher than the average turbidity at the southern sample sites. The average turbidity at the urban storm drains was found to be significantly less than the average turbidity at other types of sample sites. A significant correlation between near shore E. coli levels and turbidity was found

In this report, the aqueous and sediment results for near shore, off shore and watershed sample sites are summarized by site. In these site summaries the individual results have been transformed into z scores. The z score indicates how far and in what direction the result deviates from the average of all near shore, off shore or watershed sites, expressed in units of the distribution's standard deviation. This is a useful transformation to compare the relative standing of an individual result or site with the others.

The Lake St. Clair Assessment Project began in 1998 and now includes four years of comprehensive data on water and sediment quality in Lake St. Clair and the Clinton River Watershed. With four years of data, it is now statistically possible to begin evaluating trends and associations in water and sediment quality over time. This report summarizes historical observations in water and sediment quality from 1998 to 2001.

Summary

The primary objective of this project was to augment the existing surface water quality database for future reference and comparison. This data set extends the benchmark of water quality, which began in 1998. It represents the western portion of Lake St. Clair bordering Macomb County, including near shore, off shore, watershed and beach sample locations during the spring, summer, and fall seasons. It encompasses a wide range of parameters, including inorganic, organic and microbiological measures, for both water and sediment. Spatial and temporal trends are apparent for many parameters measured. Sediment metals, PCB and PNA data were assessed in terms of pollutant criteria developed by the United States Environmental Protection Agency and the Ontario Ministry of the Environment, giving an indication of the extent and spatial distribution of contaminated sediments in the lake and watershed.

This data set represents a working database containing water quality information for Lake St. Clair, with multiple potential utility. The database will be useful as a tool to address specific questions related to water quality in Lake St. Clair including the potential identification of streams and drains contributing specific types of pollution to the lake, pollutant dynamics, and the relationships of pollutant levels to environmental factors. Such factors may include known point and non-point source pollution inputs, land use and other landscape factors, and climatological conditions. These types of analyses may elucidate relationships and information useful to the goal of water quality improvement in the lake and surrounding watershed. This database can provide information useful to scientists, environmental protection workers, planners, natural resource and recreation managers, as well as municipalities and townships.

Future Projects and Applications

An immediate goal should be to make this database accessible to persons that may find it useful, including scientists, environmental protection workers, planners, natural resource and recreation managers, as well as municipalities and townships. Additionally, analysis of

the entire available set of existing surface water bacteria data in conjunction with spatially distributed sources of rainfall data would likely yield more conclusive information pertaining to the correlation of surface water bacteria with rainfall and CSO/RTB discharge data. A predictive model of surface water bacteria based on rainfall and other environmental data would be a useful product of this effort.

Future monitoring data will build upon the existing database, permitting evaluation of trends in water quality over time as well as space. It should reflect the previous year's results and fill data gaps, permitting more conclusive evaluation of the data. This will be useful in understanding pollutant dynamics in the lake and in the appraisal of efforts to improve water quality.